TABLE 2.—*Free-air resultant winds (m. p. s.) during July, 1928*

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Greesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Meters	°		°		°		°		°		°		°		°		°		°		°		°	
Surface	S. 15 W.	5.4	S. 4 W.	3.2	S. 80 W.	2.3	S. 63 W.	1.1	N. 43 W.	0.8	N. 18 W.	0.3	S. 11 W.	3.7	S. 17 W.	3.6	S. 73 W.	3.0	S. 81 W.	1.5	S. 88 W.	0.9	N. 42 W.	0.5
250	S. 18 W.	5.6	S. 3 W.	3.3	S. 83 W.	2.5	S. 65 W.	1.2					S. 15 W.	5.5	S. 19 W.	4.4	S. 71 W.	3.3	S. 80 W.	1.7	N. 76 W.	3.0	N. 62 W.	1.5
500	S. 17 W.	6.9	S. 12 W.	4.8	W.	3.7	S. 74 W.	1.9	N. 47 W.	0.6	N. 45 W.	0.1	S. 25 W.	7.8	S. 26 W.	6.2	S. 68 W.	4.9	S. 72 W.	3.1	N. 60 W.	4.4	N. 57 W.	2.2
750	S. 22 W.	7.8	S. 21 W.	5.2	S. 87 W.	4.0	S. 82 W.	2.2	S. 82 W.	0.7	S. 35 W.	0.9	S. 24 W.	8.1	S. 27 W.	6.4	S. 75 W.	5.7	S. 74 W.	3.9	N. 54 W.	4.4	N. 47 W.	2.7
1,000	S. 32 W.	8.0	S. 28 W.	5.1	N. 73 W.	3.7	S. 88 W.	2.4	S. 84 W.	0.9	S. 57 W.	1.3	S. 18 W.	8.1	S. 27 W.	6.1	S. 76 W.	6.8	S. 82 W.	4.5	N. 52 W.	4.8	N. 52 W.	3.0
1,250	S. 39 W.	7.6	S. 33 W.	4.8	N. 86 W.	4.8	S. 88 W.	2.8	W.	1.4	S. 70 W.	1.8	S. 14 W.	7.1	S. 26 W.	5.6	S. 77 W.	6.8	S. 84 W.	5.3				
1,500	S. 44 W.	7.0	S. 39 W.	4.5	N. 68 W.	4.6	S. 88 W.	3.7	S. 85 W.	2.5	S. 79 W.	2.6	S. 9 W.	6.5	S. 25 W.	5.1	S. 76 W.	7.8	S. 87 W.	6.2	N. 63 W.	4.9	N. 56 W.	3.9
2,000	S. 46 W.	6.4	S. 43 W.	3.8	N. 73 W.	4.2	N. 85 W.	5.2	N. 83 W.	4.2	N. 89 W.	4.0	S. 6 W.	5.0	S. 24 W.	4.2	S. 72 W.	8.4	S. 88 W.	7.4	N. 74 W.	5.6	N. 65 W.	4.7
2,500	S. 50 W.	5.1	S. 55 W.	3.8	N. 79 W.	5.9	N. 84 W.	6.4	N. 70 W.	5.7	N. 81 W.	5.7	S. 5 W.	4.5	S. 21 W.	4.0	S. 86 W.	9.1	N. 88 W.	9.7	N. 72 W.	6.0	N. 69 W.	5.8
3,000	S. 37 W.	4.1	S. 59 W.	4.1	N. 80 W.	7.2	N. 88 W.	7.9	N. 70 W.	7.8	N. 80 W.	7.5	S. 3 W.	3.8	S. 19 W.	4.1	N. 87 W.	10.3	N. 89 W.	11.2	N. 70 W.	7.8	N. 72 W.	7.3
3,500	S. 33 W.	4.8	S. 76 W.	4.4	N. 67 W.	8.0	N. 83 W.	8.3	N. 78 W.	10.0	N. 75 W.	10.1	S. 26 E.	6.5	S. 9 W.	3.2	S. 80 W.	11.5	S. 88 W.	10.8	N. 81 W.	8.1	N. 78 W.	7.9
4,000	S. 32 W.	5.5	S. 81 W.	5.3					N. 69 W.	15.7	N. 69 W.	11.5	S. 56 E.	5.4	S. 52 W.	0.9	S. 58 W.	11.2	N. 74 W.	9.7	N. 76 W.	6.8	N. 70 W.	8.2
4,500	S. 28 W.	5.9	S. 76 W.	7.2					N. 77 W.	18.3	N. 68 W.	13.7	E.	8.0	N. 25 E.	1.7	S. 67 W.	13.0	N. 62 W.	8.9	N. 70 W.	7.6	N. 82 W.	8.2
5,000													E.	7.0	N. 59 E.	3.5					S. 84 W.	7.2	N. 85 W.	8.3

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL CONDITIONS

July, 1928, was notable mainly for the closeness by which the various weather elements approached the conditions expected in a normal midsummer month. A short period of unusual warmth occurred near the end of the month in portions of the far Northwest, but otherwise temperatures were moderate. Thunderstorms or other violent electrical disturbances were not unduly frequent as a rule, and damage by wind and hail, while considerable over limited areas, was, on the whole, less than usually occurs in July.

PRESSURE AND WINDS

A survey of the daily weather maps for July, 1928, shows few cyclonic areas of importance, and precipitation was mostly of the usual thunderstorm type, heavy in some instances, but these were confined usually to widely separated areas.

The most important cyclone of the first decade was observed on the morning of the 4th over the middle Plains, whence it moved to the vicinity of the lower Lakes during the following 24 hours, attended by considerable precipitation over the region traversed. By the morning of the 6th the low pressure had apparently moved toward the middle Atlantic coast and merged with a secondary depression that had developed during the preceding night over that region. The precipitation attending this depression was rather heavy over most of the coast districts from Pennsylvania to southern New England. During the 9th and 10th considerable rain fell over an extensive area from the Great Lakes southeastward to Florida, and to the eastward on the 10th and 11th, the falls being excessive in a few localities, Greenville, S. C., having about 4 inches in less than six hours.

By the morning of the 13th low pressure had developed over the southern drainage area of the Ohio, and widespread rains had fallen over most districts from the Mississippi River eastward. During the following 24 hours the barometric depression had moved to Lake Ontario and rain had spread into all eastern districts, with heavy falls over portions of the lower Lakes, Ohio Valley, and Middle Atlantic States.

About the 17th and 18th considerable precipitation occurred over the Southeastern States, though there was no appreciable barometric depression at that time over the region of important precipitation. About the same time there was considerable precipitation over the northern Rocky Mountains and thence eastward to Lake Superior, the precipitation continuing over the western districts during the 19th and extending into the eastern lake region and North Atlantic States on the 20th and 21st.

Some local heavy rains occurred on the 21st and 22d from the middle and northern Plains eastward, the general barometric depression assuming a cyclonic form over southern New England by the morning of the 23d, more or less rain continuing over that region during the following day.

From the 26th to 28th a fairly well marked cyclone moved from western Lake Superior to the St. Lawrence Valley, attended by rather general precipitation over the Northern States from Minnesota to New England. At the same time local precipitation set in over the Gulf States, where some good rains occurred on the 26th and 27th.

Local precipitation occurred over the far Northwest during the first week, but otherwise there was little or no precipitation west of the Rocky Mountains.

Anticyclones were weak and exerted little important influence in modifying the weather over extensive areas or for lengthy periods. In fact, temperature changes were unusually small in all parts of the month and throughout nearly the entire country.

The mean pressure of the month did not depart greatly from the normal, and the pressure variations over the different parts were not sufficiently pronounced to cause important variations from the normal wind movement.

Local storms occurred, as is usual in midsummer, over the eastern two-thirds of the country, and they were rather frequent in portions of Nebraska, Iowa, and other near-by areas. No extensive loss of life was reported from tornadoes and damage from such storms was comparatively small. Full details concerning damaging winds, hail, and other storms appear at the end of this section.

TEMPERATURE

As stated elsewhere, there were no important variations in temperature as compared with the normal condition, though an unusually heated period occurred over portions of the far Northwest during the last decade. This was most severely felt over the eastern portions of Washington and Oregon, and in Idaho, where from about the 21st to

29th the temperatures were continuously high, reaching a maximum of 118° at some points, and exceeding by several degrees the highest temperatures ever previously recorded at a number of points.

The first 10 days were mainly warm and moderately dry, affording a welcome change from the cool, rainy conditions that had existed for practically the entire month of June over much of the eastern two-thirds of the country.

The week ending July 17 was mainly warmer than normal over the more western districts, but moderately cool over the central valleys and to the eastward, save over the extreme Northeastern States. Rainfall was well distributed and the week as a whole was unusually favorable for midsummer. The week ending July 24 was moderately warmer than normal in the central valleys and eastern districts and mainly cooler than normal in the mountain and plateau regions, but decidedly warm during the last few days in the far Northwest.

The last week was moderately cool over most districts from the Rocky Mountains eastward, save along the immediate Gulf and South Atlantic coasts, where it was slightly warmer than normal. West of the Rocky Mountains the week, as a whole, was mainly unusually warm, particularly in the far Northwestern States, where the weekly averages ranged from 6° to 12° above the normal, and the period of unusual continued heat was in numerous instances the longest of record.

The fairly frequent changes in temperature, though not of large magnitude, and the absence of continued excessive heat except in small areas, caused the month to be rated as physically comfortable in nearly all parts.

The average temperature for the month was close to normal in practically all portions, the only region having an excess of more than 3° being the northern portion of the plateau, where the positive departures ranged up to as much as 5°.

The highest temperatures were widely scattered as to dates, but they were particularly high on the 25th and 26th in the plateau region. The highest temperature reported was 120° in southern California, and temperatures were above 95° at some time during the month locally in all the States.

Minimum temperatures were below freezing at exposed points in all the western Mountain States; the lowest, 20°, was recorded in the high mountains of Colorado.

PRECIPITATION

As in the case of temperature, the monthly precipitation was close to the normal in practically all districts, though a few stations in the northern Great Plains had the greatest July amounts of record. The falls were mainly well distributed through the month, and at the close no important agricultural areas were suffering from a serious lack of soil moisture.

RELATIVE HUMIDITY AND CLOUDINESS

The relative amount of moisture, like the other principal weather elements, was mainly close to the normal, principally slightly above, except in the Missouri Valley, where it was materially higher than normal. Over the Southwest a moderate deficiency was fairly general, and there were slight deficiencies in the Middle Atlantic States and locally in Texas.

Much clear weather prevailed in nearly all parts of the country, particularly in the central valleys and to the westward, and similar conditions prevailed in the lake region and Atlantic Coast States. Considerable cloudy weather prevailed in the Southeastern States and portions of Florida and extreme northeastern New England

SEVERE LOCAL STORMS, JULY, 1928

The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Miller, S. Dak	1	8–9 p. m.	330		$20,000	Tornado	Farm buildings destroyed	Official, U. S. Weather Bureau.
Huron, S. Dak	1	9 p. m.	3 mi.		10,000	Wind	Hangar and airplane destroyed; many buildings damaged.	Do.
Anoka, Minn. (north of)	1	Midnight			100,000	Tornado	Extensive property damage reported	Do.
Brookings, S. Dak	1				10,000	Wind	Hangar and 1 airplane wrecked; some farm buildings damaged.	Do.
Minneota, Minn	1				60,000	Tornado	Much damage to property	Do.
Wisconsin (west-central and central).	2	12:30–2:30 a. m.			400,300	Severe squall; probably 2 small tornadoes.	Damage to barns, silos, stock, overhead wires, and crops in 7 counties.	Do.
Howard, Mitchell, and Winneshiek Counties, Iowa.	2					Hail	Damage chiefly to crops	Do.
Minatare, Nebr	3	3 p. m.	3,520		5,000	do	Crops and gardens injured in places; path 3 miles.	Do.
Shelby County, Iowa	3	9 p. m.				Tornado	Crops and buildings damaged	Do.
Crawford County, Iowa	3	P. m.			17,000	do	Character of damage not reported	Do.
Iowa	3	do				Wind and hail	Considerable damage to crops and buildings over entire State.	Do.
Stark and Peoria Counties, Ill.	3	11 p. m.	12 mi.		20,000	Wind	Buildings damaged	Do.
Stratton, Nebr	3	P. m.	3 mi.		25,000	Hail	Crops damaged 10 to 90 per cent in places over path 5 miles long.	Do.
Nebraska (central)	3–4		100 mi.		11,000	Wind	Small grain lodged; a few small buildings demolished, others damaged; path 100 miles.	Do.
College View, Nebr	4	1 a. m.			5,000	do	A business block and a residence unroofed; 2 garages demolished; trees uprooted.	Do.
Iowa	4	A. m.				Wind and hail	Heavy damage to crops and other property over entire state.	Do.
Wayne and Lenoir Counties, N. C.	4	5 p. m.			17,000	Hail	Considerable crop damage	Do.
Indianapolis, Ind., and vicinity.	4					Wind and rain	Trees and wire systems damaged; light and car service interrupted.	Do.
Elvaston, Bentley, Plymouth, and Colmar, Ill.	4				6,000	Wind	Property damaged over path 30 miles long	Do.
Lincoln, Ill. (near)	4		1,320		6,000	do	Crops flattened	Do.
Massachusetts (east-central).	4			3		Gales	Much damage to property; a number of boats capsized; traffic jammed; light and telephone service crippled; several persons injured.	Boston Herald (Mass.).

[1] "Mi." signifies miles instead of yards.